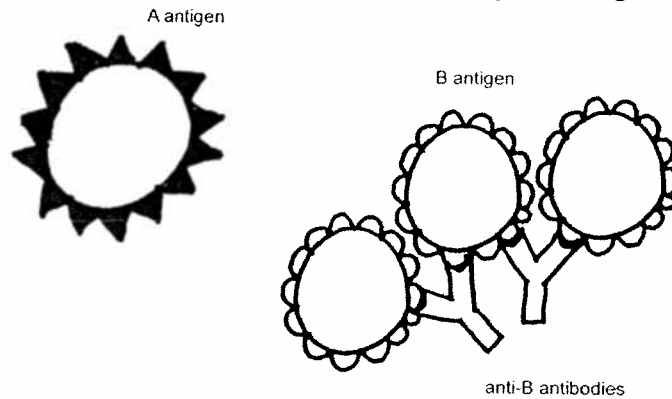


Blood transfusions — who can receive blood from whom?

If you are given a blood transfusion that does not match your blood type, antibodies present in your blood can react with the antigens present on the donated red blood cells. For example, if a person who has Type A blood is given a Type B blood transfusion, then this person's anti-B antibodies will react with the Type B antigens on the donated red blood cells and cause a harmful reaction. This reaction can cause the donated red blood cells to burst and/or clump together and block blood vessels. This type of transfusion reaction is illustrated in the following drawing.



Transfusion reactions can be fatal. To prevent this from happening, doctors test whether a person's blood is compatible with the donated blood before they give a transfusion. A person can only be given donated blood with red blood cells that do not have any antigen that can react with the antibodies in the person's blood.

Test your understanding of blood groups by completing the table below.

Blood Group	Antigens on red blood cells	Antibodies in plasma	Can receive blood from	Can give blood to
A	A	Anti-B	A and O	A and AB
B	B			
AB	A and B			
O	None			

Which blood type would be considered a universal donor (someone who can give blood to anyone)?

Genetics of Blood Types

Your blood type is established before you are born, by specific genes inherited from your parents. You receive one blood type gene from your mother and one from your father. These two genes determine your blood type by causing the presence or absence of the Type A and Type B antigen molecules on the red blood cells.

The blood type gene has three different versions or alleles:

- I^A results in A antigen on the red blood cells,
- I^B results in B antigen on the red blood cells, and
- i does not result in either antigen.

Everyone has two copies of these genes, so there are six possible combinations of alleles (called genotypes) which result in the four possible blood types (phenotypes):

- $I^A I^A$ and $I^A i$ - both resulting in Type A blood,
- $I^B I^B$ and $I^B i$ - both resulting in Type B blood,
- $I^A I^B$ - resulting in Type AB blood,
- ii - resulting in Type O blood.

In a heterozygous $I^A i$ person, which allele is dominant, I^A or i ? Explain your reasoning.

Codominance refers to inheritance in which two alleles of a gene each have a different observable effect on the phenotype of a heterozygous individual. Thus, in codominance, neither allele is recessive—both alleles are dominant.

Which one of the genotypes shown above results in a phenotype that provides clear evidence of codominance? Give the genotype and draw a picture of a red blood cell for this genotype to illustrate how both alleles influence blood type in this case.

Each biological parent gives one of their two ABO alleles to their child. For example, a father who has blood type AB has the genotype _____, so he will produce sperm with either an I^A or an I^B allele and he can give either an I^A or an I^B allele to a child of his. If the mother has blood type O, her genotype must be _____, and she can only give an _____ allele to a child of hers.

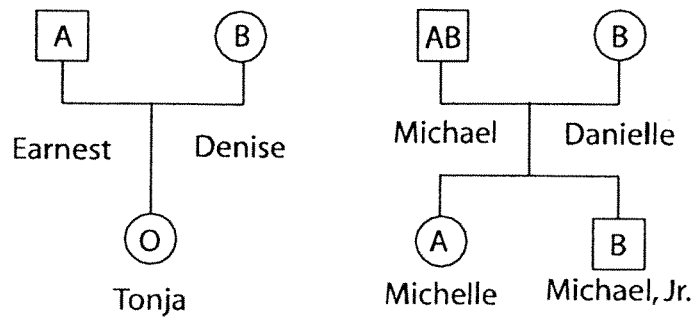
The Punnett Square below shows the possible genotypes for the children of these parents. Write in the blood type for each genotype to show the possible blood types for the children of these parents.

Father (Type AB) Sperm	Mother (Type O) Eggs	
	i	i
	I^A	$I^A i$
	I^B	$I^B i$

Next, suppose that a mother has blood Type A and genotype $I^A i$ and the father has blood Type B and genotype $I^B i$. Draw a Punnett square to show the possible genotypes for their children. Write in the blood type for each genotype.

Were the babies switched?

Now you are ready to evaluate whether Earnest and Denise's baby girl was switched with Michael and Danielle's baby girl. The following family tree shows the blood types for both families.



1. Is it possible for Michael and Danielle to have a child who has type O blood?

How do you know this?

Was a switch made at the hospital?

2. How could fraternal twins be as different in appearance as Michelle and Michael, Jr., including one having light skin and the other having dark skin?